

**Status of Known
Vulnerabilities: A Response
to Secretarial Initiatives**

East Tennessee Technology Park

November 14, 1997

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Prepared by the
Environmental Management and Enrichment Facilities
East Tennessee Technology Park
Oak Ridge, Tennessee 37831
managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
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ACRONYMS, ABBREVIATIONS, AND INITIALISMS

AIP	abandoned-in-place
AHJ	Authority Having Jurisdiction
ASA	Auditable Safety Analysis
ASO	Analytical Services Organization
CWTS	Central Waste Tracking System
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DOE-ORO	DOE Oak Ridge Operations Office
EALs	Emergency Action Levels
EH-DOE	Office of Environment, Safety, and Health
EMEF	Environmental Management and Enrichment Facilities
EMPO	Emergency Management Program Organization
Energy Systems	Lockheed Martin Energy Systems, Inc.
EO	Executive Order
ES&H	environment, safety, and health
ETTP	East Tennessee Technology Park (the former Oak Ridge K-25 Site)
FY	fiscal year
HEU	highly enriched uranium
IT&M	inspection, testing, and maintenance
MIN	materials-in-inventory
OSHA	Occupational Safety and Health Administration
PAAA	Price-Anderson Amendments Act
PC	performance category
PSM	Process Safety Management
RCRA	Resource Conservation and Recovery Act
S&MP	Surveillance and Maintenance programs
SAT	Self Assessment Team
SAR	Safety Analysis Report
SARUP	Safety Analysis Report Update Program
TDEC	Tennessee Department of Environment and Conservation
TOA	Tennessee Oversight Agreement
TSCAI	Toxic Substances Control Act Incinerator
WITS	Waste Information and Tracking System
WSS	Work Smart Standards

EXECUTIVE SUMMARY

As a result of the explosion at the Hanford Plutonium Reclamation Facility on May 14, 1997, Secretary Federico Peña directed the U.S. Department of Energy (DOE) Operations Office Managers to implement several broad-based initiatives with the purpose of identifying and preventing similar situations. Four specific initiatives were identified in the August 4, 1997, letter from Secretary Peña. The second initiative, which is the subject of this report, reads as follows

DOE field offices must reassess known vulnerabilities (chemical and radiological) at facilities that have been shut down, are in standby, are being deactivated, or have otherwise changed their conventional mode of operation in the last several years, and report status to their Program Secretarial Officers and the Assistant Secretary for Environment, Safety and Health within 120 days. Facility operators must evaluate their facilities and operations for new vulnerabilities on a continuing basis.

In addition to this initial report, a year-end progress report that addresses Secretary Peña's remaining initiatives will be submitted later this year. The process used at the East Tennessee Technology Park (ETTP) to evaluate facilities and operations on an ongoing basis will be included in that report.

This review involved a reevaluation of vulnerabilities and audit findings identified in recent, applicable Lockheed Martin or DOE assessments and audits of site facilities. The associated corrective actions, status, and health and safety impact of open corrective actions were assessed. Responses to Defense Nuclear Facilities Safety Board (DNFSB) recommendations were also included in the scope of the review. Special emphasis was given to abandoned-in-place (AIP) facilities. The audits and evaluations examined in this review identified numerous vulnerabilities. Corrective actions have been completed for most of these vulnerabilities. No new vulnerabilities were identified, and the risks associated with open corrective actions do not present imminent dangers.

Since 1993, DOE has conducted a series of assessments across the complex to identify environment, safety, and health (ES&H) vulnerabilities associated with chemicals, spent nuclear fuel, and weapons usable fissile materials (plutonium and uranium). ETTP was not included in the scope of the Spent Fuel and Plutonium Vulnerability Assessments because of the absence of these materials at the site. ES&H vulnerabilities were identified in the Chemical and Highly Enriched Uranium Vulnerability Assessments, but they were determined to present no imminent danger to workers, the public, or the environment. Low or insignificant risks are associated with open corrective actions.

Applicable DNFSB recommendations at ETTP include 94-1 (Deposit Removal Program) and 95-1 (UF₆ Cylinder Program). A reassessment of the commitments associated with these DNFSB recommendations indicates that corrective actions are being completed as scheduled, some commitments have been revised with DNFSB concurrence, and remaining open corrective actions are progressing as planned. The ES&H risks from vulnerabilities identified in these

DNFSB recommendations were assessed to be low or negligible. No open commitments were identified for other applicable DNFSB recommendations (e.g., 90-2, which included implementation of Standards/Requirements Identification Documents). The status of DNFSB Recommendation 95-2 (Integrated Safety Management Programs) will be addressed in the year-end progress report as part of ETTP's ongoing process to identify new vulnerabilities.

Following the 1993 accident at TOMSK-7 in Russia, ETTP assessed potential safety hazards associated with nitrate/organic reactions at the site. Corrective actions have been completed and recommendations are progressing on schedule. Prominent in this review was an assessment of chemical safety by the Analytical Services Organization. ETTP laboratory facilities have experienced an organic/oxidant reaction incident and similar near-miss incidents in laboratory waste streams. All corrective actions associated with the laboratory waste stream occurrences are complete. These actions included the State of Tennessee's obtaining approval to treat potentially unsafe waste streams prior to bulking of the materials.

During the summer of 1997, the DOE Office of Oversight reviewed the safety management programs at ETTP. The focus of this review was a safety management evaluation of ETTP facility disposition programs. The AIP facilities and the site reindustrialization program initiative were of particular interest in the evaluation. The DOE review recommended approximately 40 opportunities for improvement, and a corrective action plan to address these recommendations has been developed. In the present review, the hazards in the AIP facilities were reevaluated, and no new vulnerabilities were identified.

Also included in the present review were examinations of the 1997 DOE assessment of fire protection vulnerabilities, discussions of seismic safety evaluations in ETTP facilities, and a review of Price-Anderson Amendment Act reportable issues. Fire protection vulnerability corrective actions are complete. The seismic safety evaluations are being performed in response to Executive Order 12941 and, when completed, will estimate facility seismic risks and mitigation costs.

1. STATUS OF DOE VULNERABILITY REPORTS AND RECOMMENDATIONS

1.1 VALIDATION OF CONCLUSIONS FROM TOMSK-7 SELF-ASSESSMENT

1.1.1 Background

On April 6, 1993, a sequence of events occurred at the Siberian Chemical Combine at TOMSK-7 in Russia that caused substantial physical damage to the facility. A runaway exothermic chemical reaction occurred in a large process vessel that contained a concentrated solution of uranyl nitrate, nitric acid, plutonium nitrate, residual fission products, and an undetermined amount of organic constituents derived from the solvent extraction process. This reaction produced a copious amount of flammable organic and inorganic gases and steam, which pressurized and burst the vessel, dislodged the concrete cell cover, and, it is believed, ignited in the area immediately above the cell.

In response to early reports of the incident, the U.S. Department of Energy (DOE) sent a team of experts to TOMSK-7 to learn the details of the incident and subsequently initiated a series of reviews at DOE sites to assure that similar conditions do not exist in DOE processing vessels. In a February 23, 1994, letter to DOE Site Office managers, the DOE Oak Ridge Operations Office (DOE-ORO) Director of Safety and Health directed that a series of self-assessments were to be conducted based upon lessons learned from the TOMSK-7 incident.

1.1.2 Corrective Actions Planned As a Result Of Assessment

Based on the results of the assessment, the following corrective actions were planned.

- Remove (acetic and nitric acid) from Vault 301-1 to reduce the potential for incompatibility problems, and
- Remove nitric acid from Building K-1232 to reduce the potential for incompatibility with adjacent organic material.

1.1.3 Recommendations

Recommendations generated included the following:

- Complete the Safety Analysis Report Update Program (SARUP) for hazardous waste storage and processing facilities,
- Expedite plans for further segregation of potentially incompatible material and wastes,
- Update operating and fire protection procedures to clearly specify the hazards and precautions for dealing with nitric/organic constituents.

1.1.4 Status

The identified corrective actions have been completed. The SARUP for hazardous waste storage and processing facilities is on schedule. Segregation of potentially incompatible materials and wastes is an ongoing process that is being reevaluated as a result of the Peña initiative. It was determined that revising Fire Protection procedures was not necessary because the Fire Protection Department receives information from the Emergency Management Program Organization (EMPO) to determine what types of hazards might be involved. The EMPO maintains an active list of all site facilities and the associated radiological and chemical hazards.

1.1.5 Related Follow-up Actions–Analytical Services Organization

A follow-up report to the DOE Site Office dated July 22, 1994, stated that the Analytical Services Organization (ASO) was reassessing the potential for nitrate/organic reactions in waste streams due to the acid-mixing incident in June 1994. As a result of this incident involving acid mixing in a 55-gal waste drum, ASO conducted a Type C incident investigation and reassessed the potential for severe organic/oxidant reactions in waste streams at ASO. A final report entitled *Oak Ridge K-25 Site Evaluation of Safety Concerns Related to Potential Nitrate-Organic Safety Hazards-Tomsk-7 Russia Accident*, dated September 16, 1994, concluded no further potential for such reactions as a result of ASO changes to laboratory operations.

1.1.5.1 Incompatible waste incident in laboratory area and agreements with the State

In October 1995, ASO experienced an incident involving incompatible waste in a 5-gal waste container in a K-1004B laboratory satellite accumulation area. As a result of this incident and as corrective action, ASO reevaluated its chemical vulnerability and sought resolution to the conflict of Resource Conservation and Recovery Act (RCRA) requirements and safe management of wastes in the laboratory areas. In December 1995, the ASO Environmental Officer and staff from the Lockheed Martin Energy Systems, Inc. (Energy Systems) Environmental Compliance Organization met with the Tennessee Department of Environment and Conservation (TDEC) to obtain permission for the treatment of small quantities of waste at the laboratory bench to manage potentially unsafe waste. ASO obtained such permission from TDEC and agreed to (1) continue efforts to identify what mixtures are being generated in each laboratory, determine which mixtures are potential safety hazards, and identify solutions for addressing the hazards; (2) identify laboratory standard operating procedures that need to be rewritten; and (3) develop interim guidance until procedures can be modified. Corrective actions encompassed ASO operations at the three DOE sites in Oak Ridge and an off-site leased facility. The agreements reached with the State were not to be used to circumvent RCRA requirements for laboratory wastes that are not potential safety problems.

1.1.5.2 Corrective actions

In January 1996, ASO issued a *Policy for Safe Management of RCRA and TSCA Waste in the Laboratories*. In April 1996, after two near-miss incidents related to waste compatibility at the off-site facility, ASO implemented additional administrative control by requiring each analytical procedure to specify either detailed waste disposal instructions or reference an area-specific

waste disposal guide within the procedure instructions. Thus, chemical compatibility assessments are done prior to introduction of waste into a laboratory area.

1.1.5.3 Corrective action closure

All actions from the waste incident occurrences and all actions related to the State permitting treatment of wastes at the bench when there are safety hazards from bulking are complete.

1.2 VALIDATION/STATUS OF OPEN VULNERABILITIES FROM THE CHEMICAL VULNERABILITY ASSESSMENT

1.2.1 Background

In 1994, Secretary of Energy Hazel O’Leary directed the Office of Environment, Safety, and Health (DOE-EH) to lead a broad-based review to identify chemical safety vulnerabilities that confronted DOE. The Chemical Safety Vulnerability Working Group was formed. This working group, which was composed of professionals representing DOE’s line and contractor organizations, worked in partnership with DOE-EH to carry out this mandate.

Identified vulnerabilities and supporting observations were described in the *Chemical Safety Vulnerability Working Group Report* (DOE/EH-0398P). DOE/EH-0398P specified that applicable sites would prepare Comprehensive Response Plans to report their vulnerabilities and would address vulnerabilities requiring mitigation to comply with regulations, standards, and DOE directives. *The Comprehensive Site Response Plans to the Chemical Safety Working Group (Comprehensive Response Plans)* was issued October 25, 1995, under cover letter from Robert W. Poe, Assistant Manager for Environment, Safety, and Quality, to Joseph E. Fitzgerald Jr., Deputy Assistant Secretary for Worker Health and Safety, EH-5. Eight generic vulnerabilities and programs associated with each were discussed. The three generic vulnerabilities identified in DOE/EH-0398P as requiring “priority attention” were also addressed, and actions, both proposed and in progress, were specified. The *Comprehensive Response Plans* cover letter declared that these plans were acceptable, and the letter provided evidence to demonstrate that adequate levels of chemical awareness and safety existed. Regarding vulnerabilities specific to East Tennessee Technology Park (ETTP), the following sections address proposed and approved actions included in the *Comprehensive Response Plans*, action status, and known health and safety impacts associated with actions remaining open.

1.2.2 Generic Vulnerabilities for Chemical Safety

1.2.2.1 Abandoned and residual chemicals

Materials-in-Inventory (MIN) Effort. In November 1992, DOE requested information about “materials not categorized as waste,” specifically defined as materials not being used but held in storage for future use, recycling, or recovery. DOE summarized the results in its MIN report published in November 1994. A multi-site report (ES/M-9, *Materials in Inventory*) was submitted to DOE in 1995 regarding the approach to continuing the MIN initiative for chemicals.

In February 1997, a follow up to the MIN effort was submitted to Mr. R. R. Nelson in a report from Mr. L. A. Felton. This report provided a status of selected materials in the initial MIN report.

Status: In addition to DOE's MIN program, vulnerabilities associated with ETP MIN-related chemicals are addressed by SARUP, other facility/emergency hazard analysis initiatives, and numerous ETP Standard Practice Procedures, Immediate Action Directives, and Energy Systems programs. These procedures and programs will be discussed in the year-end report as part of ETP's ongoing process of evaluating new vulnerabilities.

Health and Safety Impact of Open Action: No open actions.

SARUP. SARUP is designed to develop safety authorization basis documentation for DOE facilities that meets DOE expectations and requirements. As stated by the *Comprehensive Response Plans*, Phase I of SARUP included a careful examination of all facilities, regardless of operational status, for radiological and non-radiological hazards.

Status: Complete for nuclear facilities. To be completed in FY 1998 for non-nuclear hazardous facilities. ETP has completed its SARUP requirements with the exception of a few waste management facilities.

Health and Safety Impact of Open Action: The SARUP for Waste Management facilities will be completed in FY 1998. Until completion of the SARUP effort, the health and safety risks associated with this open action are judged to be the following:

- K-1232, Chemical Recovery Pit—negligible risk
- K-1302, Fluorine Storage—low risk
- K-1036-A, RCRA Drum Storage—low-moderate risk

Emergency Preparedness Planning. ETP has developed an Emergency Management Program to address DOE 151.1 requirements. A comprehensive description of potential hazards, hazard sources, and consequences was developed for each ETP facility to evaluate the total range of emergency event scenarios (ESS-EM-103, *Hazard and Consequence Assessment*). Emergency Action Levels (EALs) were developed using the event/symptom, the subsequent event(s), and the event classification as defined by ESS-EM-109, *Classification of Emergencies*.

Status: Complete. EAL matrixes were developed for event classification and emergency response and documented in K/SS-657, *Oak Ridge ETP Emergency Action Levels (EAL) Classification Guide*. This guide is used in conjunction with K/SS-586, *K-25 Site Emergency Plan*. These documents will be unified under a "reservation emergency plan."

Related emergency preparedness requirements and actions cited by the Comprehensive Response Plan (all complete):

1. For specified facilities, conduct a radiological/toxicological sabotage assessment in accordance with DOE Order 5632.1C, *Protection and Control of Safeguards and Security Interests*.

Status: Complete. K/OPS-034, *Oak Ridge K-25 Site Radiological/Toxicological Sabotage Assessment*, was issued August 15, 1996. This is a classified document.

2. Provide detailed hazard assessments to the Tennessee Emergency Management Agency in accordance with the Tennessee Oversight Agreement (TOA), Sect. B.17, Scope.

Status: Complete. The current TOA was effective June 28, 1996. The aforementioned action is specified in Attachment G, *Emergency Preparedness Scope*. This requirement is met by hazard assessments provided by the ETTP Emergency Management Program.

3. The Clean Water Act, Sect. 311(j)(5) as amended by the Oil Pollution Act of 1990, required ETTP to conduct a hazard and consequence assessment of a worst-case oil- or hazardous-substance discharge and to develop a facility response plan.

Status: Complete. The ETTP Emergency Preparedness Program documented the response plan in K/SS-681, *Oak Ridge K-25 Site (ETTP) Facility Spill Response Plan*.

1.2.2.2 Inventory control and tracking

Two programs are cited by the *Comprehensive Response Plans* as ensuring the tracking of chemical inventories. These programs are the Hazardous Materials Inventory System and the Waste Tracking System.

To meet TOA waste-tracking requirements and to support Energy Systems multi-site needs, a Central Waste Tracking System (CWTS) was to be designed and implemented to provide consolidated reporting capability. CWTS planning and development went through a number of phases, evolving into a program called the Waste Information and Tracking System (WITS). The WITS conversion for ETTP and the Y-12 Plant is scheduled for November 24, 1997.

Status: Ongoing. WITS is to be implemented by November 24, 1997.

Health and Safety Impact of Open Action: No impact because ETTP is currently using an existing waste tracking system until WITS is implemented.

1.2.2.3 Other generic vulnerabilities

For the other generic vulnerabilities, the *Comprehensive Response Plan* described existing systems and programs to mitigate and reduce these vulnerabilities. No ETTP action items were identified with the following generic vulnerabilities:

- Past chemical spills,
- Characterization of spills,
- Planning for disposition of chemicals,
- Chemical storage practices,
- Condition of facilities and safety systems, and
- Unanalyzed hazards.

1.2.3 Priority Vulnerabilities

Listed below are the action items and status of the priority vulnerabilities that are specific to ETTP.

1.2.3.1 Removal of excess or unneeded chemicals

K-25 Building Deposit Removal. The status of this program is described in Sect. 1.4.

Cylinders of Depleted Uranium Hexafluoride. The status of this program is described in Sect. 1.5.

Normal Assay Lithium Hydroxide For Disposition. Approximately 83% of the lithium hydroxide has been successfully shipped offsite to five different companies. Approximately 9,000 drums of 55,000 original drums remain to be shipped by January 1998. The project will be completed under budget and ahead of schedule.

Health and Safety Impact of Open Action: Very low risk. The risk factors are related to the consequences of fire and associated reaction of lithium hydroxide with fire water. The unshipped material is overpacked and stored in K-25 Building basement vaults. Hazard analysis results are documented in K/OPS-050, *Basis for Interim Operation of the HEU Process Building K-25 at the East Tennessee Technology Park*.

Accountable Lithium Compounds. There has been successful disposition of some of the material, but the exact amount remaining is classified information.

Health and Safety Impact of Open Action: Very low risk. See the response above for normal assay lithium hydroxide.

1.2.3.2 Proper storage of chemicals—revised SARUP Implementation Plan

A revised SARUP Implementation Plan was scheduled to be submitted to DOE in fall 1995.

Status: Complete. The ETTP Implementation Plan was submitted to DOE as planned. Bi-monthly status reports are provided to DOE.

1.3 VALIDATION/STATUS OF OPEN VULNERABILITIES FROM HIGHLY ENRICHED URANIUM VULNERABILITY ASSESSMENT

1.3.1 Background

In March 1994, Secretary of Energy Hazel R. O’Leary directed DOE to conduct an assessment of ES&H vulnerabilities associated with the storage of weapon-usable fissile materials across the DOE complex. The ES&H vulnerability assessment for highly enriched uranium (HEU) storage was initiated by the Secretary in February 1996 and was completed in August 1996. ETTP was not included in the scope of the accompanying Plutonium Vulnerability Assessment or the Spent Fuel Vulnerability Assessment because neither of these materials were present at the site.

HEU is defined as uranium at least 20% of which is the fissile isotope uranium 235 (U-235). The potential for ES&H vulnerabilities associated with HEU at the Oak Ridge K-25 Site was assessed. This assessment, performed by a team of the site’s technical experts, consisted of a study of document research, personnel interviews, and facility walkdowns. The site self assessment team’s (SAT) results were subsequently validated by a DOE-HQ Working Group Assessment Team. *The Highly Enriched Uranium Working Group Report*, DOE/EH-0525 (Vol. I: Summary and Vol. II: No. 7), was reviewed during this reassessment.

1.3.2 Findings, Observations, and Recommendations

Seven facilities were identified with HEU. Three facilities, K-25, K-1420, and K-1004A had a total of nine vulnerabilities identified. Four facilities had no vulnerabilities due to adequate controls or very small quantities of HEU.

Potential consequences that resulted in an effect on the worker, the environment, or the public were identified as potential vulnerabilities and further evaluated. Four of the nine HEU vulnerabilities were in the K-25 Building, four were in Building K-1420, and one was in Building K-1004-A. None of the vulnerabilities are considered high-risk. Two vulnerabilities associated with potential for an inadvertent nuclear criticality event have high consequences, but the likelihood of these events is highly unlikely, thus mitigating the resulting risk.

1.3.3 Corrective Actions Status

The approved corrective actions for the nine vulnerabilities identified in the HEU Vulnerability Assessment at ETTP and their status is shown in Table 1.

Table 1. ETTP HEU Vulnerability Corrective Actions

No.	Facility	Vulnerability	Corrective Action	Status
1	K-1004	SAT 001, Material Release—Worker drops glass vial containing HEU material, and glass breaks, releasing contents on floor.	Material is to be placed in a cushioned, non-breakable overpack. The containment will only be opened in a ventilation hood. This action was completed August 9, 1996, and this activity closes the vulnerability.	Closed
2	K-1420	SAT 001, Material Release—Water from leaks in roof, window damage, sprinkler system freeze, or human error spreads loose material from Fluorination Tower Room.	Loose material from the Fluorination Tower Reactor Room was removed on August 29, 1996. The loose uranium material and other fine debris were collected and placed in safe storage. This project completed the corrective action for this vulnerability.	Closed
3	K-1420	SAT 002, Material Release—Human error or electrical short circuit results in fire, which spreads loose contamination from the Fluorination Tower Room.	Combustibles were removed from the Fluorination Tower Room. Furthermore, as described above for SAT 001, loose uranium material from the fluorination tower reactor room was removed August 29, 1996. This project completed the corrective action for this vulnerability.	Closed
4	K-1420	SAT 003, Material Release—Earthquake or wind event spreads HEU material to the environment.	<p>Along with the material containerization project in the Fluorination Tower Reactor Room, which is complete, compensatory measures are being planned to seal the piping and other vessels containing HEU material. This will minimize the likelihood of a natural phenomena event causing a material release. Subject to budget availability, this action is scheduled for completion by September 30, 1998.</p> <p>Removal of the residual HEU material will be accomplished as part of the decontamination and demolition of the K-1420 Building. Current scheduling for these measures shows final demolition beginning in FY 2007 and continuing through FY 2010*.</p>	Open
5	K-1420	SAT 004, Criticality—An earthquake damages equipment, water from sprinklers and/or rain moderates HEU material, and material accumulates in geometry that results in criticality.	<p>Along with the material containerization project that was completed August 29, 1996, in the Fluorination Tower Reactor Room, compensatory measures are being planned to seal the piping and other vessels containing HEU material. This will minimize the likelihood of a natural phenomena event causing the collection of HEU material into an unsafe geometry. Subject to budget availability, this action is scheduled for completion by September 30, 1998.</p> <p>Removal of the residual HEU material will be accomplished as part of the decontamination and demolition of the K-1420 Building. Current scheduling for these measures shows final demolition beginning in FY 2007 and continuing through FY 2010*.</p>	Open
6	K-25 Fissile Storage Vault	SAT 001, Material Release—Human error and/or fire ruptures material packaging and spreads HEU material, which is currently in a fissile storage vault.	HEU material, which is stored in the vault, was transported to the Y-12 Plant for permanent storage by December 31, 1996.	Closed

*A more aggressive plan is under consideration in which demolition of the K-1420 Building will be completed by the end of FY 2006.

Table 1. ETP HEU Vulnerability Corrective Actions (continued)

No.	Facility	Vulnerability	Corrective Action	Status
7	K-25 Holdup	SAT 002, Material Release—Intense fire results in structural and equipment damage leading to release of HEU material.	The highly combustible resin that accounts for the potential intensity of a fire has been sold. The combustible resin material has been removed from the building. Administrative controls will limit the combustible materials stored in the building. Phase I of the K-25 Site Deposit Removal Program is underway and is scheduled to be complete by the end of FY 1999. Phase I includes the stabilization of the deposits from the K-25 Building that are greater than 500 g of U-235 and located in unfavorable geometry. Removal of the remaining HEU material will be accomplished through the Large Scale Metal Recycle Project currently planned for FY 1998 through FY 2007.	Closed
8	K-25 Holdup	SAT 003, Material Release—An earthquake damages equipment, water from sprinklers and/or rain entrains HEU material, and material is spread and/or carried from the building.	Phase I of the K-25 Site Deposit Removal Program is underway and is scheduled to be complete by the end of FY 1999. Phase I includes the stabilization of deposits from the K-25 Building that are greater than 500 g of U-235 and located in unfavorable geometry. Removal of the remaining HEU material will be accomplished through the Large Scale Metal Recycle Project currently planned for FY 1998 through FY 2007.	Open
9	K-25 Holdup	SAT 004, Criticality—An earthquake damages equipment, water from sprinklers and/or rain moderates HEU material, and material accumulates in geometry that results in criticality.	Phase I of the K-25 Site Deposit Removal Program is underway and is scheduled to be complete by the end of the FY 1999. Phase I includes the stabilization of deposits from the K-25 Building that are greater than 500 g of U-235 and located in unfavorable geometry. Removal of the remaining HEU material will be accomplished through the Large Scale Metal Recycle Project currently planned for FY 1998 through FY 2007.	Open

*A more aggressive plan is under consideration in which demolition of the K-1420 Building will be completed by the end of FY 2006.

1.3.4 Discussion of Open Vulnerabilities and Associated Risks

As shown in Table 1, two vulnerabilities remain open in each of two facilities (buildings K-1420 and K-25) at ETP. In each building, the vulnerabilities are related to radiological material releases or an inadvertent nuclear criticality in which the initiator is a natural phenomena event.

The likelihood of a material release from the K-1420 facility and consequences to personnel were estimated to be **Low**. The condition of the building structure is degrading, otherwise, the likelihood of this event would have been categorized as **Very Low**. Some compensatory measures have been completed and others are planned to minimize the potential for a material release. The environmental consequences were estimated to be **Medium** because of the potential for measurable off-site contamination.

Although the consequences of an inadvertent nuclear criticality event in the K-1420 facility were estimated to be **High** for the worker, the risk to the worker is mitigated by the fact that the estimated likelihood of this event is considered to be **Very Low**. Consequences to the public and the environment would be insignificant.

The likelihood of a material release from the K-25 Building or an inadvertent nuclear criticality event was estimated to be **Very Low**. The consequences of these accidents to workers, the public, and the environment are the same as those described for the K-1420 facility. Compensatory measures in the K-25 Building include Deposit Removal Program activities to reduce the quantities of hold-up uranium materials in the facility.

These four vulnerabilities remain open until the Large Scale Metals Recycle Project is implemented in each of these facilities. The Building K-25 schedule depicts this project to begin in FY 2003 and continue through FY 2007. The Building K-1420 schedule shows work beginning in FY 2007 and continuing through FY 2010. A more aggressive plan is under consideration, however, in which the demolition of the K-1420 Building will be completed by FY 2006.

1.4 REASSESSMENT/STATUS OF DNFSB RECOMMENDATION 94-1 (DEPOSIT REMOVAL PROGRAM)

1.4.1 Background

The Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 94-1 on May 26, 1994. DOE accepted the DNFSB's recommendation on August 31, 1994. The DNFSB noted in Recommendation 94-1, that it was concerned that the halt in production of materials to be used in nuclear weapons froze the manufacturing pipeline in a state that, for safety reasons, would not be allowed to persist unremediated. In its implementation plan dated February 28, 1995, DOE broadened the scope of the response to Recommendation 94-1 to include additional bulk liquids and solids containing fissile materials and other radioactive substances in spent fuel storage pools, reactor basins, reprocessing canyons, processing lines, and various facilities that require conversion to forms, or establishing conditions, suitable for safe interim storage. The scope was broadened to ensure that similar materials under similar conditions receive the same degree of management attention as those noted by the DNFSB in its recommendation.

During the operating life of the facilities at ETTP, isotopically enriched uranium accumulated as deposits inside equipment and piping as a result of wet air leakage to certain process components. The K-25 Building was shut down in 1964. In 1985 it was determined that the K-25 Site gaseous diffusion facilities were in excess of uranium enrichment needs, and they were placed in standby. The decision was made to permanently shut them down in 1987. Deposits of enriched uranium remain in the piping and equipment. Based on field nondestructive assay measurement, it was determined that some of the enriched uranium deposits in the K-25 Building present an unacceptable criticality risk based on requirements in DOE Order 5480.24, *Nuclear Criticality Safety*. In 1989 steps were taken to reduce the likelihood of a criticality event by welding closed the numerous openings in process piping that could have allowed water leakage.

1.4.2 DNFSB Recommendation 94-1 Implementation Plan

The Deposit Removal Program was officially initiated during 1991. After Recommendation 94-1 was issued, the scope of the project was determined to be 65 deposits of HEU in the K-25 Building with a uranium mass of greater than 500 g. The original schedule projected completion of this scope of work in April 1999. Deposits of low enriched uranium in other process buildings were not included in the scope of the project.

1.4.3 Corrective Actions

During February and March 1996, four deposits of HEU were removed from large diameter pipes in the K-25 Building.

1.4.4 Follow-up Evaluations

In January 1997, efforts were initiated to reevaluate the deposits of concern within the scope of the Deposit Removal Program. Prevention of a nuclear criticality event is the basis for this evaluation. Nuclear criticality prevention is based on the double contingency principle contained in American National Standard ANSI/ANS-8.1 (Ref. 8.2). This principle has been revised by DOE Order 5480.24 to state

Process designs shall incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions (contingencies) before a nuclear criticality accident is possible.

To implement this principle, criticality safety is to be provided by either (1) the control of at least two independent nuclear parameters or (2) a system of multiple controls on a single nuclear parameter. The number of controls required upon a single controlled nuclear parameter is dependent upon the control reliability and any features that mitigate the consequences of a control failure.

The overall plan and approach was presented to the DNFSB in July 1997 and was favorably received. The current scope of the project includes stabilization in the K-25 Building of nine pieces of process equipment that contain HEU and three pieces of process equipment in the K-29 Building that contain low enriched uranium. A detailed criticality evaluation is currently being performed for less significant deposits and will be reviewed by independent criticality safety experts from other facilities. The DNFSB is aware that the scope is subject to change based on the final outcome of the evaluation and the independent reviews.

1.4.5 Current Status

Four of the nine deposits in the K-25 Building have been stabilized, and one of the three deposits in the K-29 Building has been stabilized. The revised milestones for the DNFSB Recommendation 94-1 Implementation Plan include placing these twelve deposits in safe configuration by March 31, 1998. Efforts are currently on schedule, and timely completion of this milestone is expected.

1.5 REASSESSMENT/STATUS OF DFNSB RECOMMENDATION 95-1 (UF₆ CYLINDERS)

1.5.1 Background

In response to Secretary Peña's request to review safety management system principles and functions, the UF₆ Cylinder Project reassessed both the DOE Chemical Vulnerability Assessment of 1994 and the DNFSB Recommendation 95-1, which detailed poor maintenance and storage conditions of depleted uranium hexafluoride (DUF₆).

1.5.2 Recommendations

On the basis of the issues identified in these two reports, the following three recommendations regarding the storage of DUF₆ inventory were issued.

- Start an early program to renew the protective coating of cylinders,
- Explore the possibility of additional measures to protect cylinders from exposure to elements, and
- Institute a study to determine whether a more suitable chemical form should be selected for long-term storage.

To facilitate safe and integrated management of the DUF₆ inventory, a systems engineering approach was initiated. This approach focuses on defining the risks, identifying system requirements, and implementing actions through a series of seven documents and implementing procedures. The seven documents are Systems Requirements Document, System Engineering Management Plan, Program Management Plan, Engineering Development Plan, and site-specific safety analysis reports (SARs). To date, all seven documents have been developed and approved and are being used to successfully control the numerous activities that enable the safe storage of the DUF₆ inventory at ETTP, Paducah, and Portsmouth until ultimate disposition.

As instructed by the DOE Implementation Plan for Recommendation 95-1, the UF₆ Cylinder Project is focusing on and emphasizing five activities.

1. Relocate cylinders from ground contact and keep all cylinders from further ground contact.

Status: The cylinders historically in ground contact have been removed. Because of the design and age of some yards, additional ground contact is anticipated. Periodic inspections are in place to identify these cylinders so that actions can be taken.

2. Relocate all cylinders into an adequate inspection configuration.

Status: This activity is underway and requires yard construction, which is also underway.

3. Repaint cylinders as needed to avoid excessive corrosion.

Status: To date, over 2100 whole cylinder bodies have been repainted at Paducah. In addition, cylinder skirted regions are being cleaned and painted.

4. Update handling and inspection procedures and site-specific SARs.

Status: The SARs have been developed and approved, the handling and inspection procedures have been revised, and personnel have been trained to apply the revised procedures. Efforts are now underway to incorporate newly identified administrative controls from the approved SARs into appropriate procedures to ensure additional mitigation and/or prevention of risks.

5. Complete an ongoing study that will include an analysis of alternative chemical forms for the material.

Status: SARs for the cylinder yard operations at ETTP, Portsmouth Gaseous Diffusion Plant, and Paducah Gaseous Diffusion Plant have been developed. SARs identified the hazards associated with the existing cylinder yard operations and evaluated their significance by examining the possible accident scenarios that could result from the hazards. It was concluded that activities associated with the cylinder yard operations can be conducted with acceptable risk, given the implementation and continuation of identified preventive and mitigative controls. DOE approval of the SARs conveys that the risks of continued storage of DUF₆ inventory are acceptable. In addition, preparation of an Environmental Impact Statement is underway. Preliminary results indicate that alternative chemical forms have comparable risks from a systems perspective.

Reassessment of the commitments associated with this vulnerability reveals that all deliverables have been completed on time and that they have been approved. Additionally, it was determined that all remaining open activities are progressing as planned. The overall conclusion of this review is that potential consequences of previously identified vulnerabilities are judged to be negligible. Thus, the UF₆ Cylinder Project will continue its mission to safely store the DUF₆ inventory until ultimate disposition.

1.6 STATUS OF RESPONSE TO DOE-EH SAFETY MANAGEMENT EVALUATION

The DOE Office of Oversight reviewed the safety management programs at ETTP in May and June 1997 and issued a report of the review on September 24, 1997. The focus of the review was consideration of the safety management of disposition of surplus facilities. The review identified three broad issues as described below and 39 recommended opportunities for improvement to address the issues.

1. ETTP Decontamination and Decommissioning and Surveillance and Maintenance programs (S&MP) need increased Environmental Management and DOE-ORO management attention, prioritization, and resources to ensure safe and timely disposition of high-risk buildings.

2. The reindustrialization program needs to be implemented in a more controlled and systematic manner to ensure definition of DOE roles, responsibilities, authorities, and liabilities; identification of ES&H requirements; and effective safety oversight.
3. The management infrastructure essential to the effective management of issues arising from events, accidents, and near-misses needs to be strengthened to ensure continuous improvement in safety management and sharing and implementation of lessons learned.

An Interim Corrective Action Plan addressing the issues was established by DOE-ORO in September 1997. The Interim Plan indicated that a number of corrective actions were being taken before the final report was issued, with some actions already completed. A corrective action plan response to the final report was submitted to the Office of ES&H in October 1997.

1.7 STATUS OF RESPONSE TO DOE-EH PSM TECHNICAL ASSISTANCE VISIT

1.7.1 Background

On August 6–7, 1996, representatives from the DOE Field Support Office and a representative from Pacific Northwest National Laboratory made an assistance support visit to Oak Ridge to assist DOE-ORO in determining a baseline for the Process Safety Management (PSM) programs at Oak Ridge. DOE Order 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, requires DOE contractors who manufacture explosives or work with threshold or larger quantities of highly hazardous chemicals, flammable liquids, or gases to successfully implement the requirements of the Occupational Safety and Health Administration (OSHA) rule for PSM of Highly Hazardous Chemicals (29 CFR 1910.119). The official ruling by DOE's Office for Interpretation of OSHA, was that the Toxic Substances Control Act Incinerator (TSCAI) Flammable Tank Storage Operations are covered by the PSM rule.

1.7.2 Corrective Action

The identified corrective action specifies that TSCAI operations should comply with the requirements of the OSHA rule for Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119) for the storage of flammable materials. This includes a requirement to issue a Process Hazard Analysis by May 26, 1997.

1.7.3 Status

TSCAI generated and issued an Auditable Safety Analysis (ASA) that, after review, was determined to adequately address the elements of a Process Hazard Analysis as required under 29 CFR 1910.119. The ASA was approved by DOE in December 1995, and it met the requirement to have an initial Process Hazard Analysis completed by May 26, 1997. The TSCAI PSM manual, to be issued in October 1997, adequately addresses the remaining elements of 29 CFR 1910.119.

1.8 STATUS OF RESPONSE TO ISSUES IN DOE-ORO FIRE PROTECTION REVIEWS

1.8.1 Background

From January 27, 1997, until February 7, 1997, DOE-ORO staff conducted a review of fire protection issues at ETTP facilities. The review examined key management issues within the Fire Protection Program to assess the level of vulnerabilities found and provide management with objective alternatives for resolution.

Two issues were identified (1) the need for management to perform further assessments in determining required funding for the Fire Department against potential reduced inspection, testing, and maintenance (IT&M) needs and emergency response capability and (2) an acceptable process for deactivation of fire suppression systems within abandoned facilities.

1.8.2 Findings, Observations, and Recommendations

ETTP Issue #1 Fire Department Operations' emergency response and IT&M capabilities are eroding, and management has not identified an acceptable level of protection.

ETTP Issue #2 The contractor management process for fire protection sprinkler system deactivation is inadequate.

1.8.3 Corrective Actions

For the purpose of clarifying the response, issues were reduced to sub-issues.

Sub-issue 1a: Fire Department Operations' emergency response capability is eroding.

Prospects seem unlikely for obtaining additional funding needed to increase the Fire Department staff to the level needed.

Action: The proposed correction is to implement the *Common Response Plans*, which allows the use of Fire Department operations response personnel from both the Y-12 Plant and ORNL to supplement ETTP on-site resources in combating actual interior fire fighting events.

Status: The Common Response Plans concept has been approved and is being implemented. Additionally, concurrence by contractor management at each of the three Oak Ridge DOE-ORO sites is complete.

Sub-issue 1b: Fire Department Operations' inspection, test, and maintenance capability is eroding. The review team discussed the workload in the Fire Department by comparing the number of automatic sprinkler systems and associated alarm systems located at ETTP with the required IT&M frequencies for these systems.

Action: The proposed correction is to submit a formal request to approve, as equivalent, a set of reduced frequencies for IT&M activities. Additional relief will be sought through continued efforts to deactivate fire protection systems in buildings that do not present fire hazards and those that are suited for abandoning in-place (see discussion of ETTP Issue No. 2).

Status: The implementation of reduced frequencies for the IT&M activity is consistent with the latest DOE guidance as explained in the *ORO Fire Prevention and Protection Implementation Guides*, Edition 8.

ETTP Issue No. 2: The process used to deactivate fire sprinkler systems on February 2, 1997, was inadequate. The systems were in three buildings in S&MP that were placed in abandoned-in-place (AIP) status. The review team concluded that the decision process used in deactivating the systems was inadequate, but it did not conclude that the systems needed reactivation.

Sub-issue 2a: Develop an approach to deactivating sprinkler systems acceptable to the DOE-ORO Authority Having Jurisdiction (AHJ) and other stakeholders that clearly identifies the level of stakeholder participation.

Action: A systematic process based on DOE-HQ implementation guidance for DOE Order 420.1, *Facility Safety*, has been submitted and will be utilized.

Sub-issue 2b: Determine a process for proper sprinkler system “lay-up.” This option relates to steps needed to protect water-based fire suppression systems from freeze damage when deactivating them in abandoned buildings without heat and utilities.

Action: A draft deactivation process has been submitted and will be utilized.

Sub-issue 2c: Submit a Request for Change to Standard/Requirements Identification Documents to use the implementation guide for DOE Order 420.1, *Facility Safety*. However, it was recognized by the review team that this step may not be necessary if the implementation guide regarding deactivation of fire protection systems is adopted as a Work Smart Standard (WSS) during Phase II of the WSS process. Indeed, the second part of the review team’s third option was to coordinate adoption of this guide as part of the Environmental Management and Enrichment Facilities (EMEF) Program WSS set.

Action: The Phase II WSS Identification Team has included DOE Order 420.1 as part of the implementation guidance for the EMEF Program WSS set.

Sub-issue 2d: Develop a policy jointly with DOE regarding the expected actions for the Fire Department when responding to AIP buildings or other buildings where sprinkler systems have been deactivated.

Action: The “stand off and protect” fire fighting approach has been submitted as a part of the deactivation process for DOE approval.

Sub-issue 2e: Appoint an AHJ at the contractor level for fire protection matters. This option reflects the team's concern about involvement of the appropriate authorities in the decision process for deactivating fire protection systems.

Action: The ETPP Site Manager appointed an AHJ contractor on April 30, 1997.

2. STATUS OF OTHER VULNERABILITIES

2.1 STATUS OF SEISMIC STUDIES DEVELOPED FOR DOE EXECUTIVE ORDER 12941

Executive Order (EO) 12941, *Seismic Safety of Existing Federally Owned or Leased Buildings*, requires federal agencies to develop an inventory of their buildings, evaluate the seismic safety of the buildings, and prepare cost estimates for mitigating unacceptable risks for buildings in that inventory. DOE-Headquarters issued the *DOE Management Plan to Implement EO 12941* as the guidance for DOE sites to follow. The DOE management plan defines four phases for the implementation of EO 12941. These phases are (1) inventory, (2) evaluation, (3) cost estimation, and (4) report. The first three phases have been completed, and the report will be completed.

The inventory phase indicates that there is a total of 452 buildings at the ETTP site. Of these 452 buildings, 361 buildings were exempted from any evaluations or cost estimates as instructed by the DOE management plan. After the exemption process, 91 buildings were identified as requiring evaluations and cost estimates.

The DOE management plan identifies 16 model building types for categorization of the non-exempted buildings. The ETTP site has buildings in ten of the model building types. From the population of the non-exempt buildings, there are 27 buildings classified as performance category (PC) 2 or 3. The PC 2 and 3 buildings could contain hazardous materials inside the buildings. Of these 27 buildings that are PC 2 or 3, seven model building types are represented. These 27 buildings and their model building type are listed in Table 2.

The DOE management plan does not require an evaluation of all non-exempt buildings. It specifies that at least one building from each model building type be evaluated, which is the approach used at ETTP. Past evaluations can also be used if they were performed for a criteria that satisfies the EO requirements. The results from the specific buildings evaluated are then used to extrapolate to the total population of non-exempt buildings.

The specific PC 2 or 3 buildings evaluated as part of the EO 12941 implementation are also identified in Table 2. The results of the specific EO 12941 evaluations were used, along with past evaluations that satisfied the EO 12941 requirements, to extrapolate the conclusions for the other buildings listed. The buildings that satisfy the EO 12941 requirements are identified in the table as O.K., and the buildings that do not satisfy the requirements are listed as N.G.

The EO 12941 evaluations are primarily focused on (1) the life safety of the occupants in case of a collapse of the building and (2) determining cost estimates. The evaluations are sufficient to judge whether or not a building will collapse. If the building is listed as N.G., which suggests potential collapse, there could be a potential for damage to equipment or tanks that contain hazardous materials. If the building is listed as O.K., the building will not collapse, but detailed evaluations of equipment, tanks, piping, and other material inside the building have not been made as part of the EO 12941 evaluation.

Table 2. Types and Status of EO 12941 Non-exempt PC 2 or PC 3 Buildings

Building	Status	Notes
<i>Type 2—Wood, Commercial and Industrial</i>		
K-1003	O.K.	Used past evaluations of similar buildings to extrapolate
K-1025-C	O.K.	Used past evaluations of similar buildings to extrapolate
K-1058	O.K.	Used past evaluations of similar buildings to extrapolate
<i>Type 3—Steel Moment Frame</i>		
K-1055	O.K.	Evaluated K-1225 and used past evaluations of similar buildings to extrapolate
K-1652	O.K.	Evaluated K-1225 and used past evaluations of similar buildings to extrapolate
<i>Type 4—Steel Braced Frame</i>		
K-25	N.G.	Used past evaluations of similar buildings to extrapolate
K-27	O.K.	Used past evaluations of similar buildings to extrapolate
K-29	N.G.	Used past evaluations of similar buildings to extrapolate
K-31	N.G.	Used past evaluations of similar buildings to extrapolate
K-33	O.K.	Used past evaluations of similar buildings to extrapolate
K-1650	O.K.	Used past evaluations of the building to extrapolate
K-1515-H	O.K.	Used past evaluations of similar buildings to extrapolate
<i>Type 5—Steel Light Frame</i>		
K-1065-A	O.K.	Extrapolated from evaluations for K-1435-C
K-1065-B	O.K.	Extrapolated from evaluations for K-1435-C
K-1065-C	O.K.	Extrapolated from evaluations for K-1435-C
K-1065-D	O.K.	Extrapolated from evaluations for K-1435-C
K-1065-E	O.K.	Extrapolated from evaluations for K-1435-C
K-1425	O.K.	Extrapolated from evaluations for K-1435-C
K-1435-A	O.K.	Extrapolated from evaluations for K-1435-C
K-1435-B	O.K.	Extrapolated from evaluations for K-1435-C
K-1435-D	O.K.	Extrapolated from evaluations for K-1435-C
K-1435-C	O.K.	Evaluated
<i>Type 10—Concrete Frame with Infill Shear Walls</i>		
K-802	O.K.	Extrapolated from K-601 evaluation
<i>Type 15— Unreinforced Masonry Bearing Walls</i>		
K-1004-A	N.G.	Evaluated
K-1004-B	N.G.	Extrapolated from K-1004-A evaluation
K-1004-C	N.G.	Extrapolated from K-1004-A evaluation
<i>Type 16— Other</i>		
K-1004-L	N.G.	Extrapolated from K-1004-A evaluation

2.2 STATUS OF PRICE-ANDERSON AMENDMENTS ACT REPORTABLE ISSUES

Price-Anderson Amendments Act (PAAA) reportable issues related to radiological vulnerabilities were reviewed. All reportable issues were classified as minor by the LMES Senior Review Board and all corrective actions have been closed.

2.3 REASSESSMENT OF KNOWN VULNERABILITIES IN AIP FACILITIES

This section is an assessment of vulnerabilities associated with facilities in the S&MP that have been declared AIP. The AIP Program is an ongoing effort to strictly control access to specific shutdown facilities assigned to the S&MP. The mission of the AIP Program is to perform activities necessary to reduce or eliminate existing hazards while limiting the general plant population from entering the facilities. This is achieved by performing some stabilization activities, such as removing combustible material, waste, and surplus equipment/material, and by removing equipment from service while posting the facility as AIP. An access authorization permit must be completed to gain access to a facility that has been declared AIP. The permit serves to authorize the requested activity, track the number of entrants, and assign temporary responsibility for activities and waste disposal.

This assessment was conducted by evaluating the existing safety documentation for each facility; compiling the pertinent data into a report (Appendix A); and then reviewing the data with the facility managers, subject matter experts and other qualified individuals. Chronic hazards, such as asbestos, were screened during this process. Acute hazards were included in the report, although they may not be chemical related (e.g., electrical hazards). A status review of all auxiliary systems was conducted during this hazard review. No new vulnerabilities were identified during this review.

The breakdown of the assessment was of 79 facilities: four Radiological, ten Non-Nuclear, 65 Other Industrial or General Accepted. The four radiological facilities are K-631, K-1131, K-1300 and K-1410. Of the “Radiological” facilities, Building K-631 has a 2.5-ton depleted uranium test weight cylinder, K-1131 has four UF₆ cylinders, the K-1300 stack has uranium deposits, and K-1410 has high contamination levels. The ten Non-Nuclear facilities are the individually identified process “tie-lines.” The process tie lines were used to move process gas between buildings. The facilities categorized as Other Industrial and General Accepted are detailed within the report.

Appendix A

VULNERABILITY ASSESSMENT FOR ETP ABANDONED-IN-PLACE FACILITIES